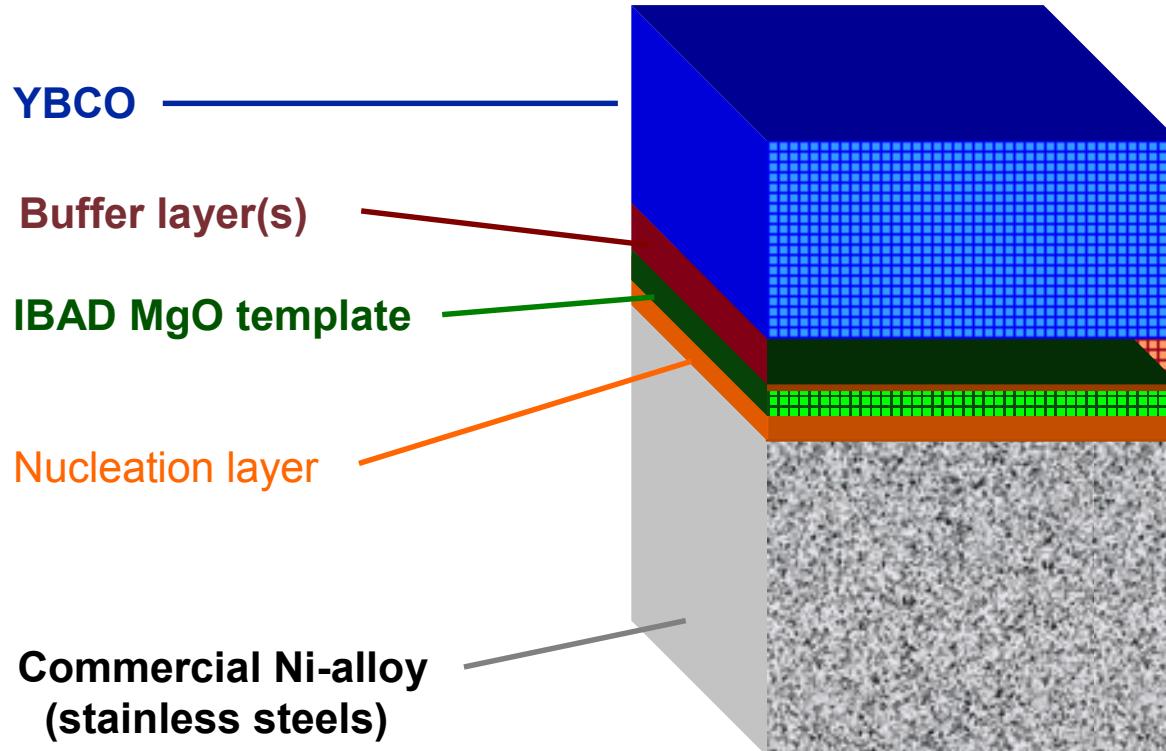


Biaxially textured IBAD MgO templates

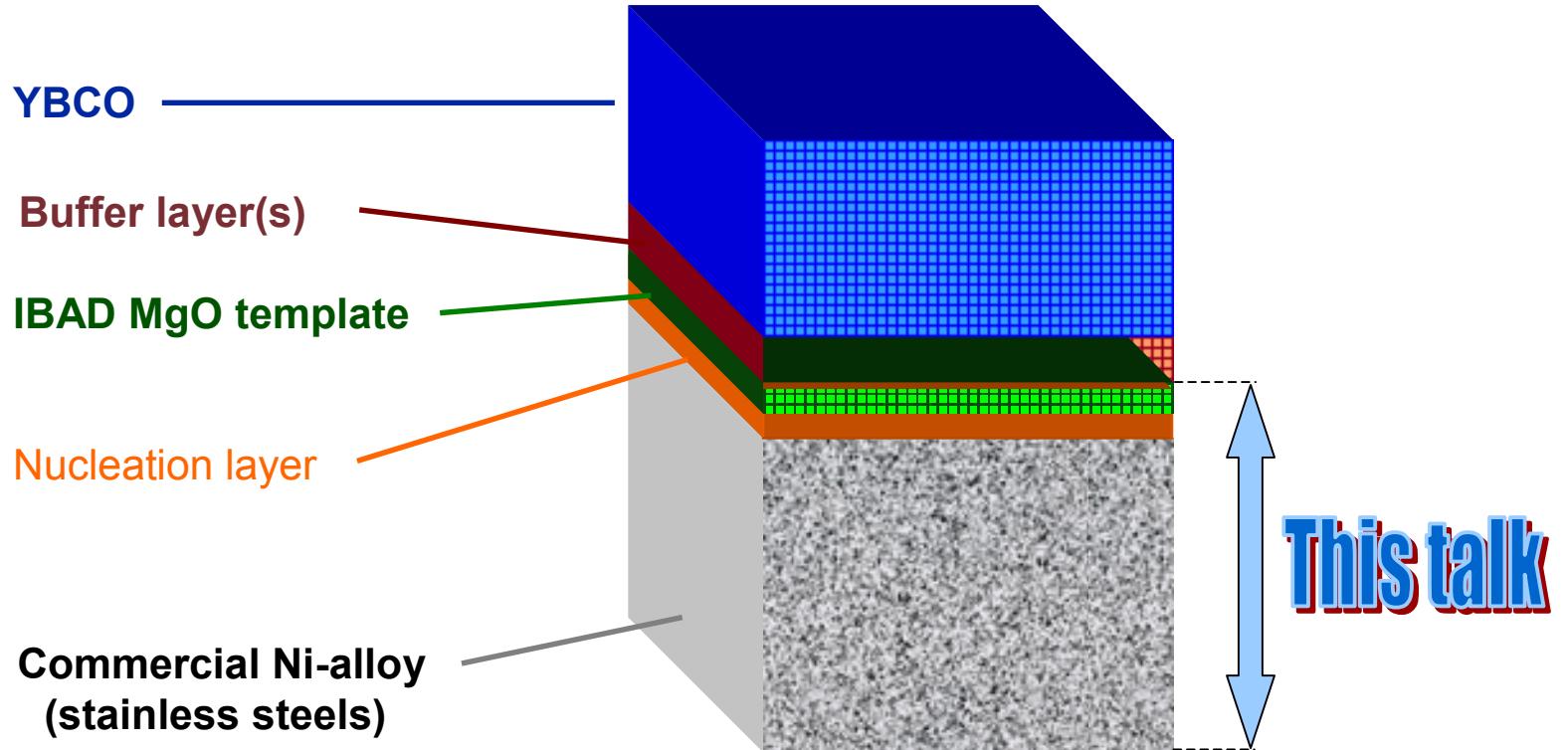
P. Arendt, S. Foltyn, Q. X. Jia, R. Groves,
T. Holesinger, V. Matias,
R. DePaula, L. Stan, A. Findikoglu,
S. Kreiskott, Y. Li, H. Wang

*Superconductivity Technology Center
Los Alamos National Laboratory*

Los Alamos coated conductor architecture

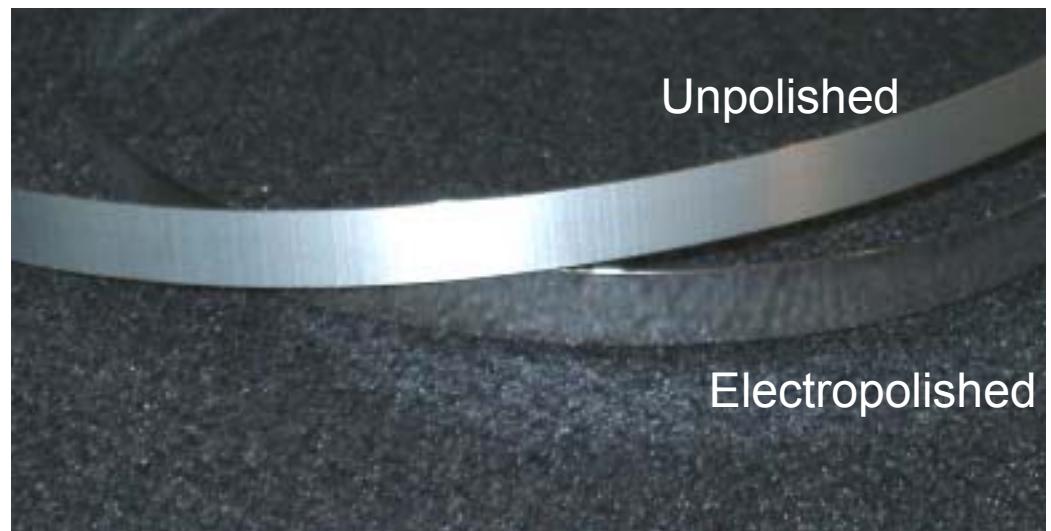


Los Alamos coated conductor architecture



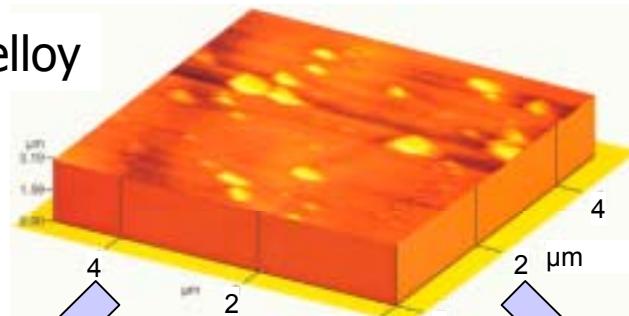
Ni-alloy substrate finishing uses standard industrial processing technique

- Coated conductors using IBAD MgO templates require metal substrates which possess smooth (~ 1 nm) and clean surfaces
- Industrial-type electro polishing equipment processes reels of metal tape
- Capable of reel-to-reel polishing of tape at high speed up to km lengths



Fine Scale Surface Structure - AFM

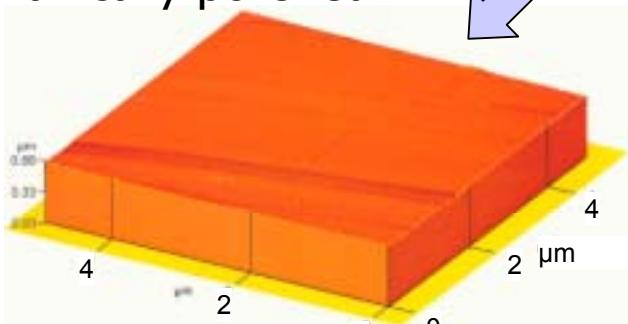
Unpolished Hastelloy



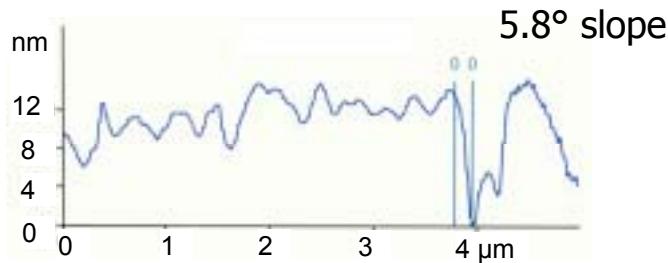
RMS roughness
(AFM $5 \times 5 \mu\text{m}$):

- 17 nm (avg.), 7 nm (line)

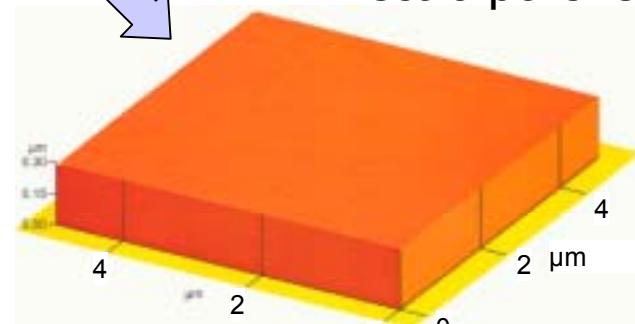
Mechanically polished



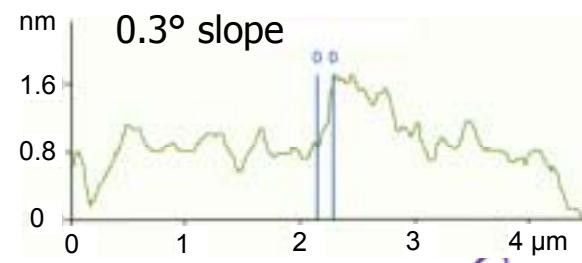
- 3 nm (avg.), 0.3 - 13 nm (line)



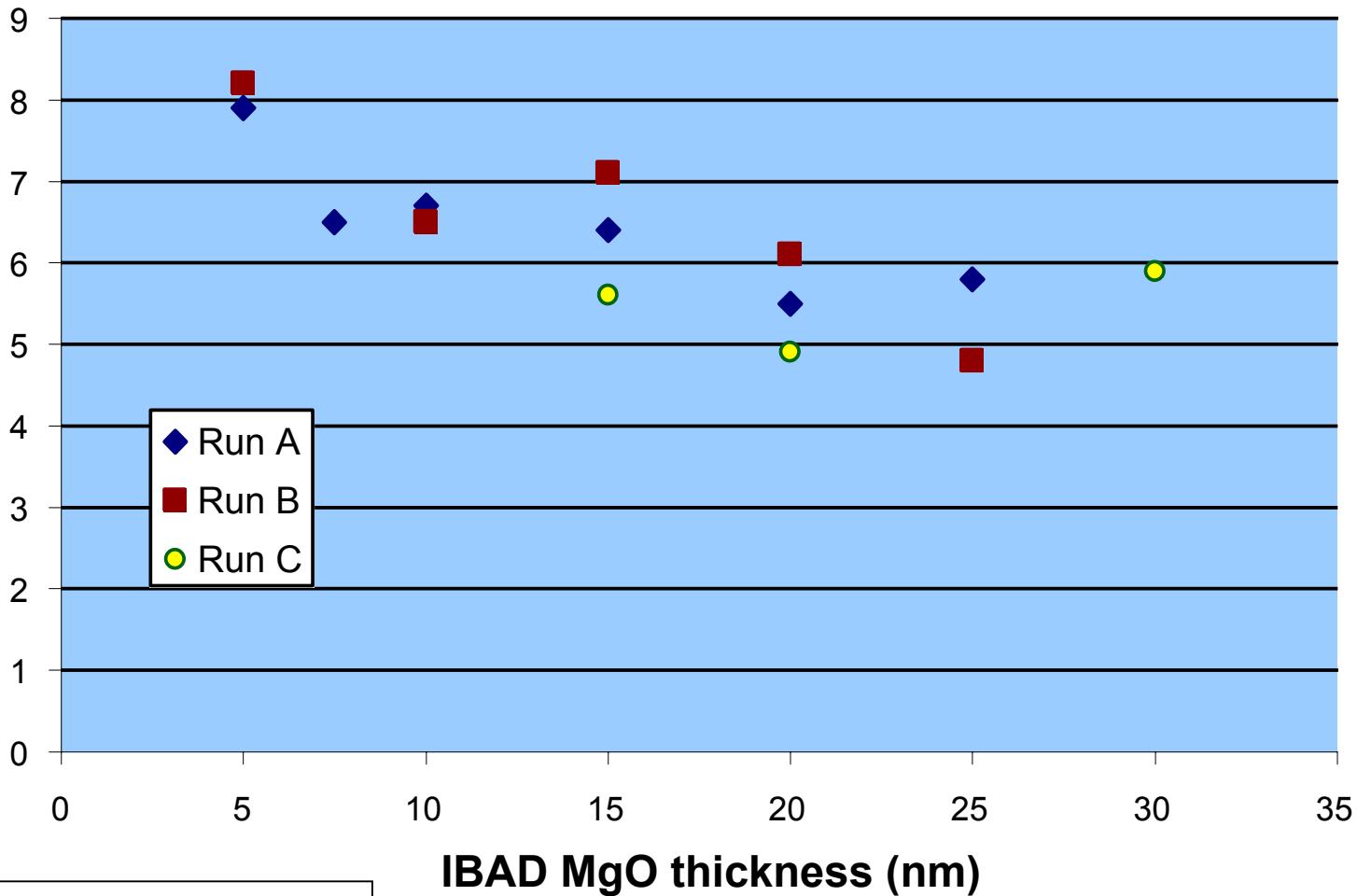
Electro polished



- 0.4 nm (avg.), 0.2 - 0.4 nm (line)



In-plane texture dependence vs. IBAD MgO thickness



*Homoepi MgO/IBAD MgO/ a -Y₂O₃/Si

Processing speed for IBAD MgO deposition

Current (reel-to-reel system)

~ 0.1 nm/s with 12 cm x 1 cm deposition zone
(Deposit 9 nm thick template)
⇒ 12 min/m ⇒ 5 m/hr

Projected

~ 0.1 nm/s with 10 cm x 60 cm deposition zone*
⇒ 250 m/hr
⇒ 6.0 km/24 hr day

*Y. Iijima et al., 2001 International Workshop on Superconductivity, June 24-27,
Honolulu, HI

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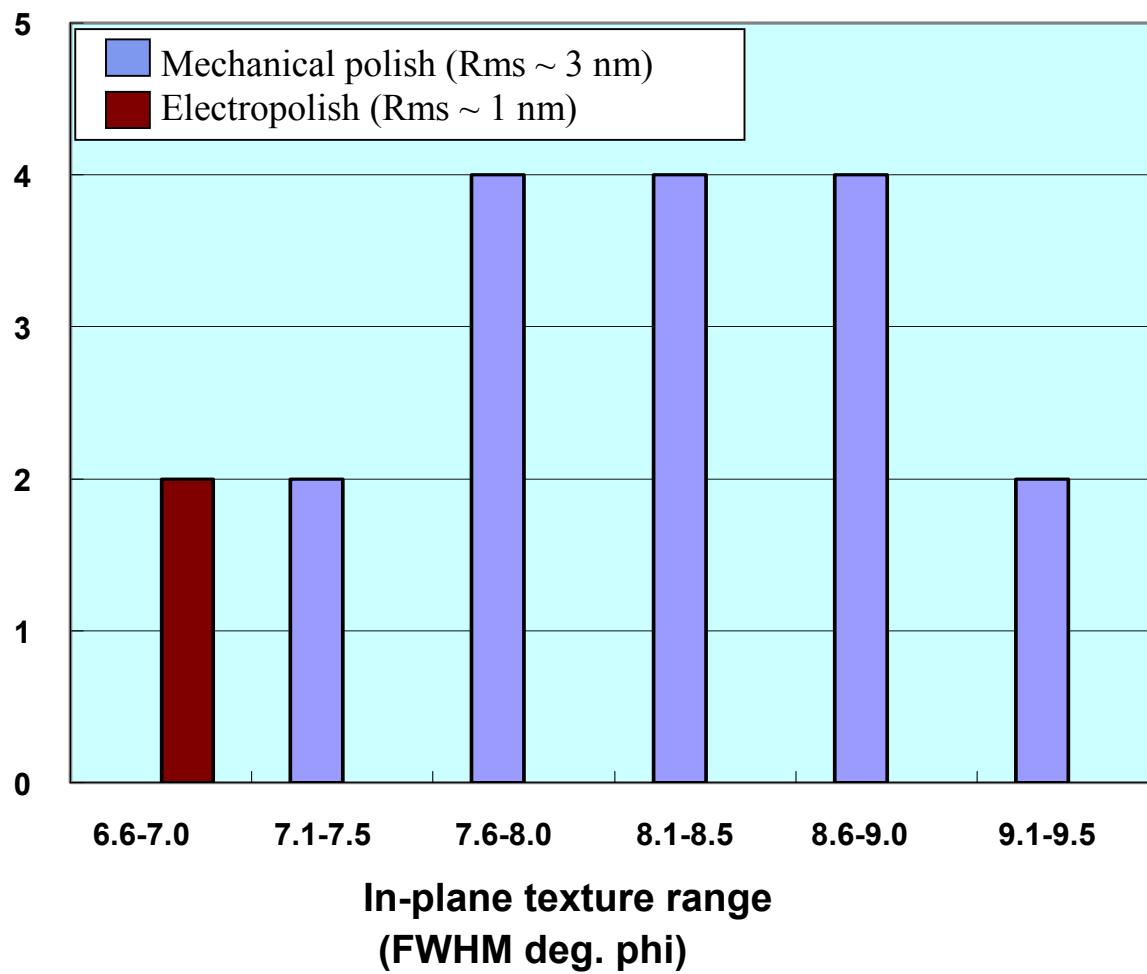
Projected

~ 0.1 nm/s with 10 cm x 60 cm deposition zone
⇒ 250 m/hr
⇒ 6.0 km/24 hr day

***Initial results to higher deposition rates (0.2-0.3 nm/s)
result in comparable texture for the IBAD MgO**

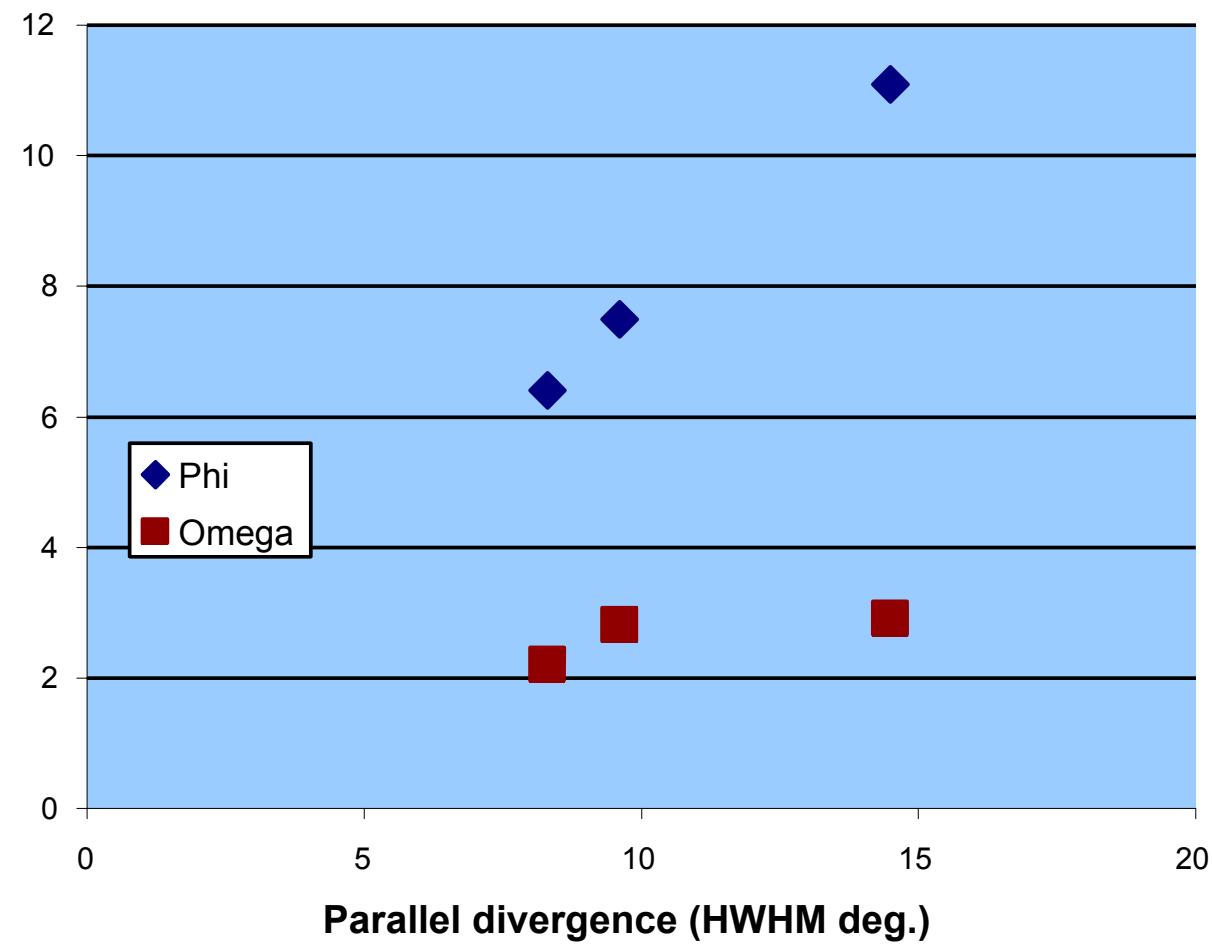
IEEE Trans. Appl. Superconductivity* **11 2823 (2001)

IBAD MgO in-plane texture - reproducibility of continuously processed meters



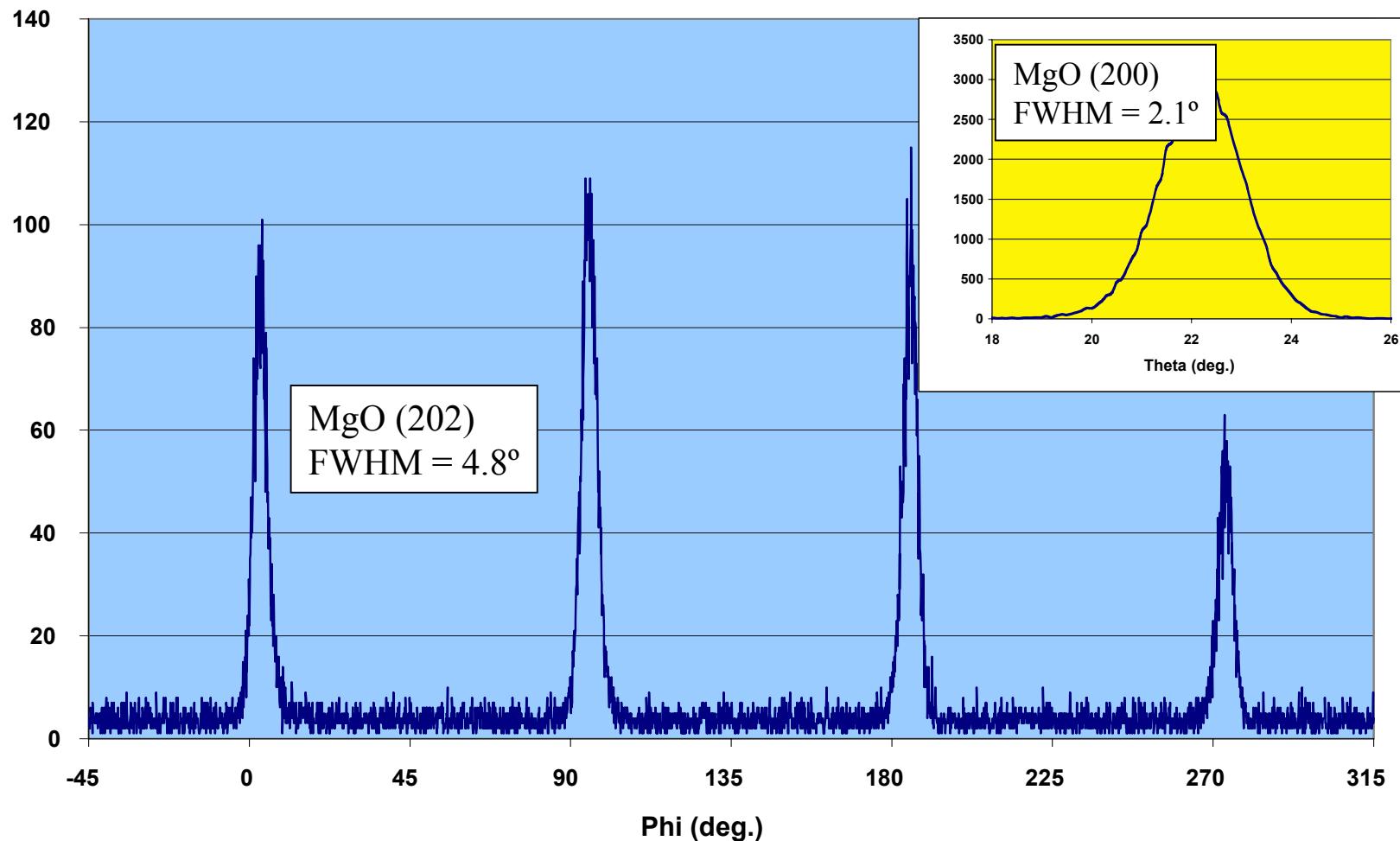
Homoepi MgO/IBAD MgO/ a -Y₂O₃/Ni-alloy

IBAD MgO texture can be improved by decreasing the assist ion beam divergence



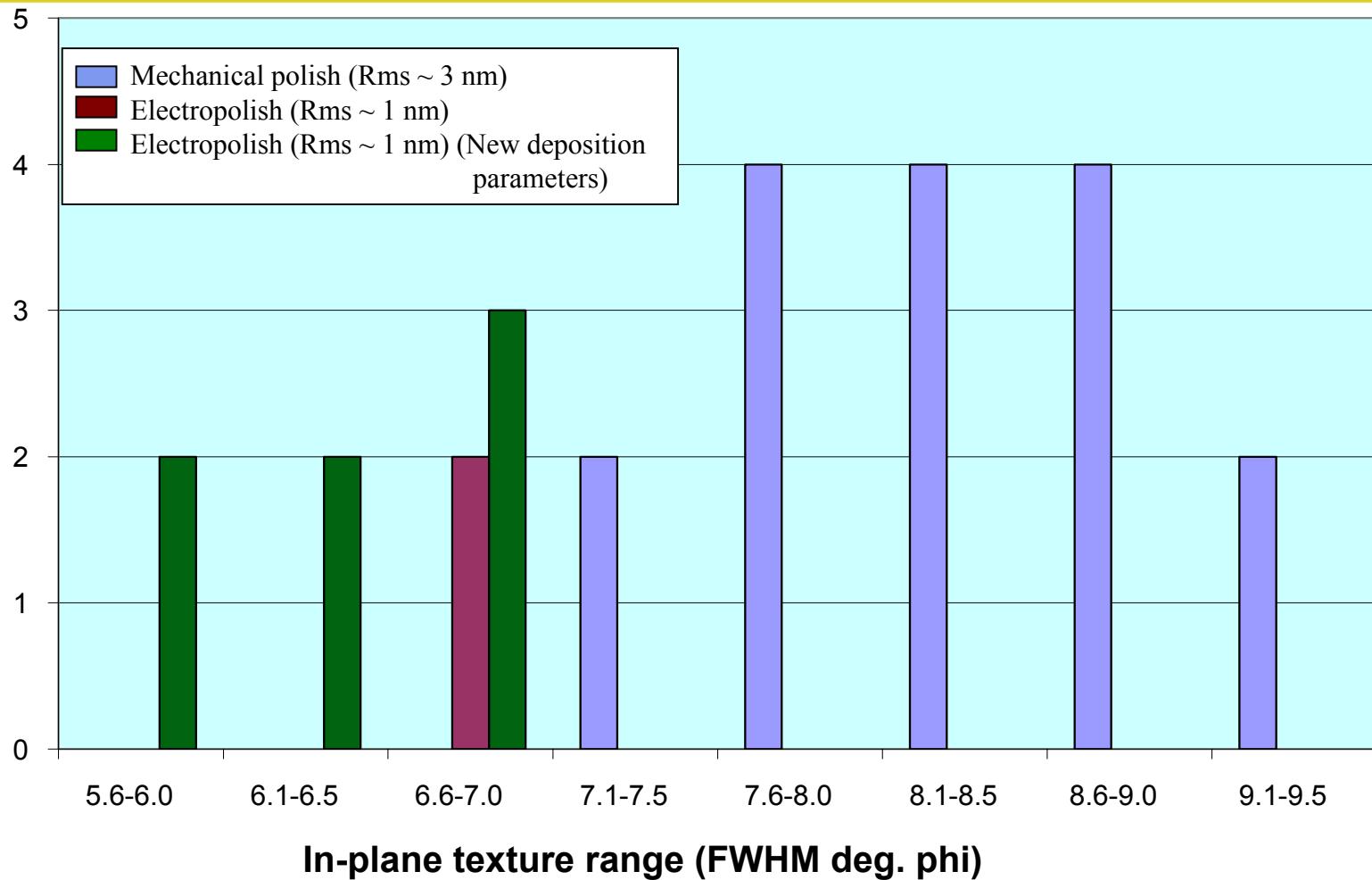
*Homoepi MgO/IBAD MgO/ a -Y₂O₃/Si

Assist beam optimization experiments led to improved texture for IBAD MgO templates



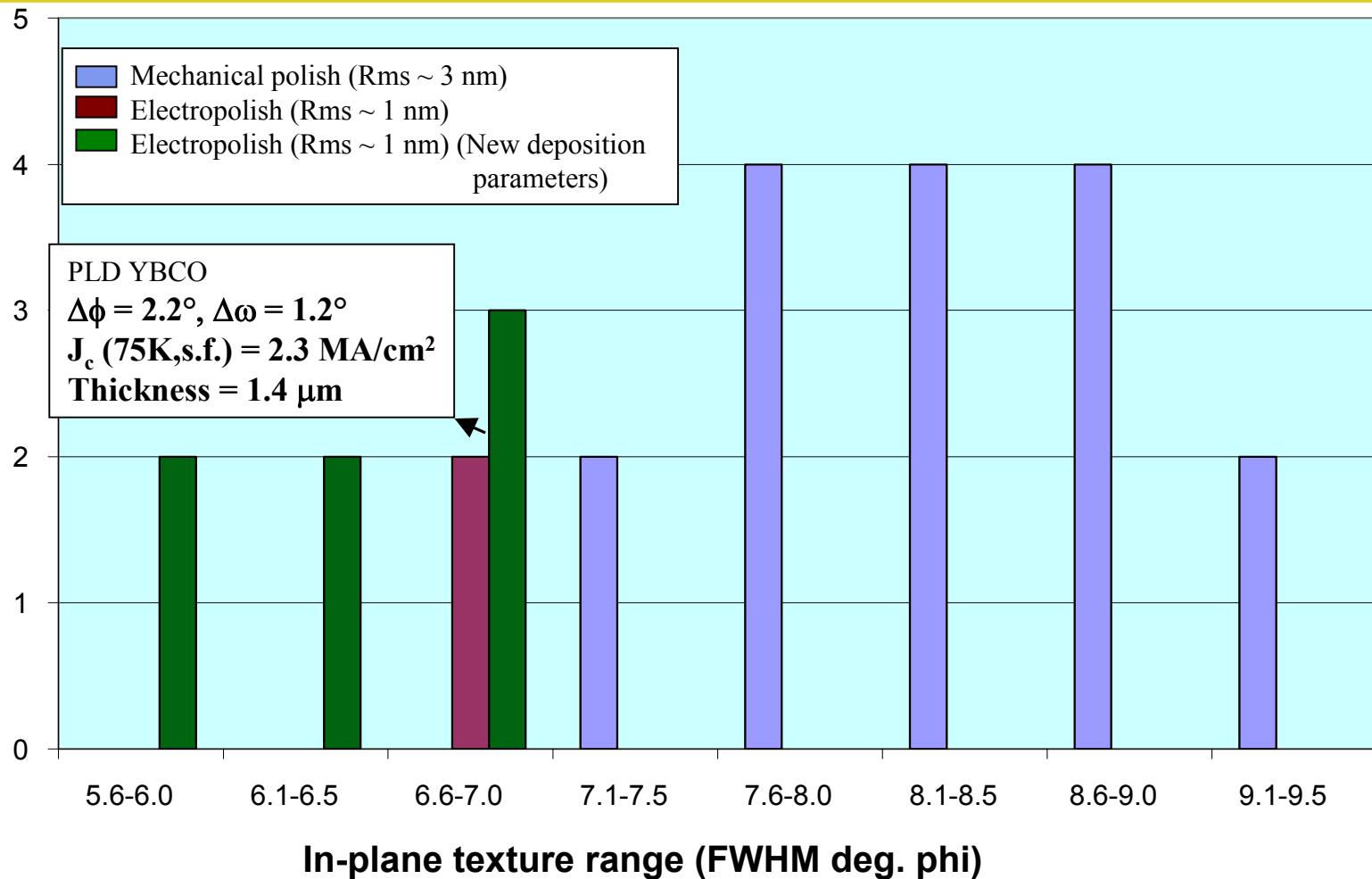
*Homoepi MgO/IBAD MgO/ a -Y₂O₃/Si

IBAD MgO in-plane texture - reproducibility of continuously processed meters



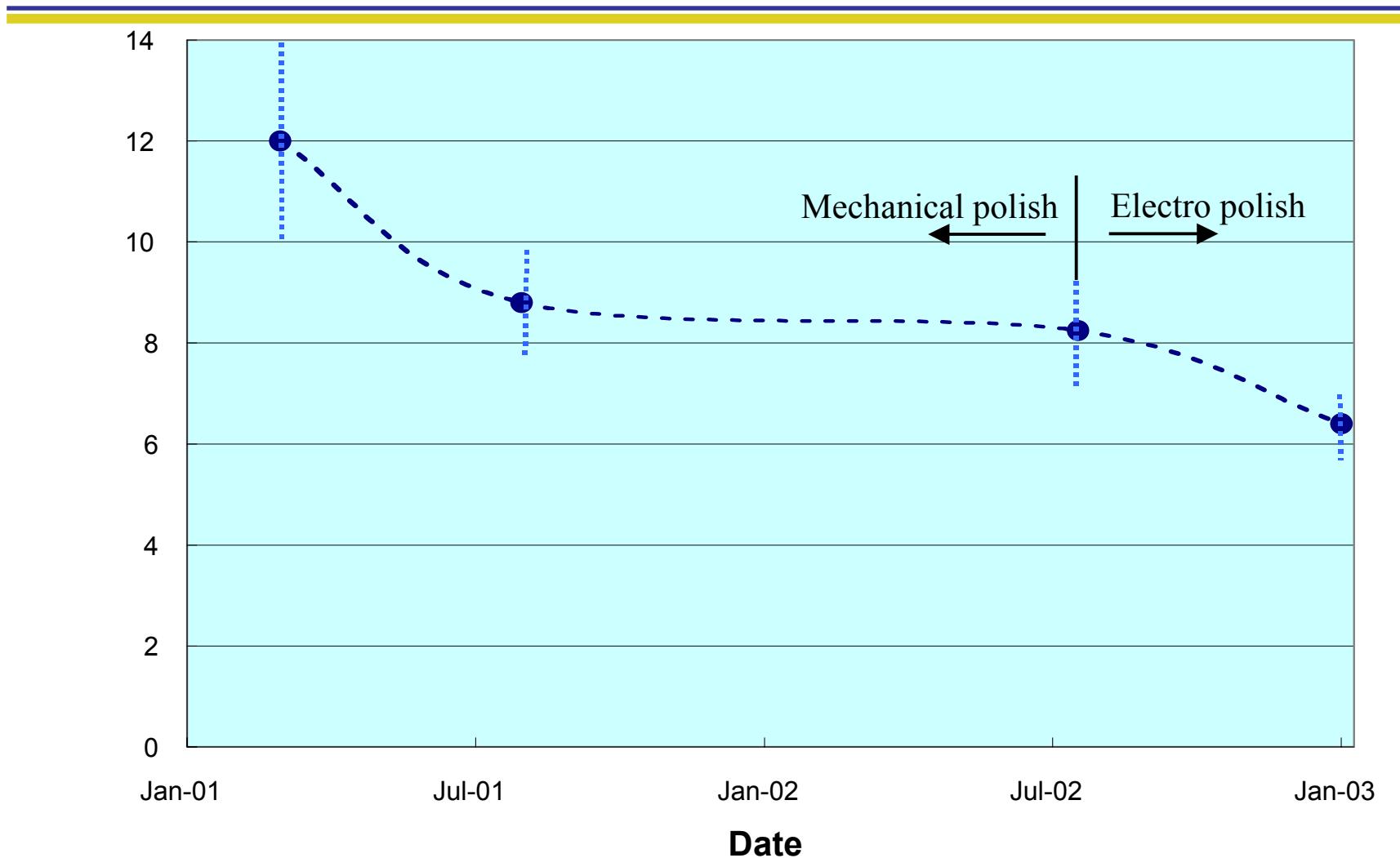
Homoepi MgO/IBAD MgO/ a - Y_2O_3 /Ni-alloy

IBAD MgO in-plane texture - reproducibility of continuously processed meters

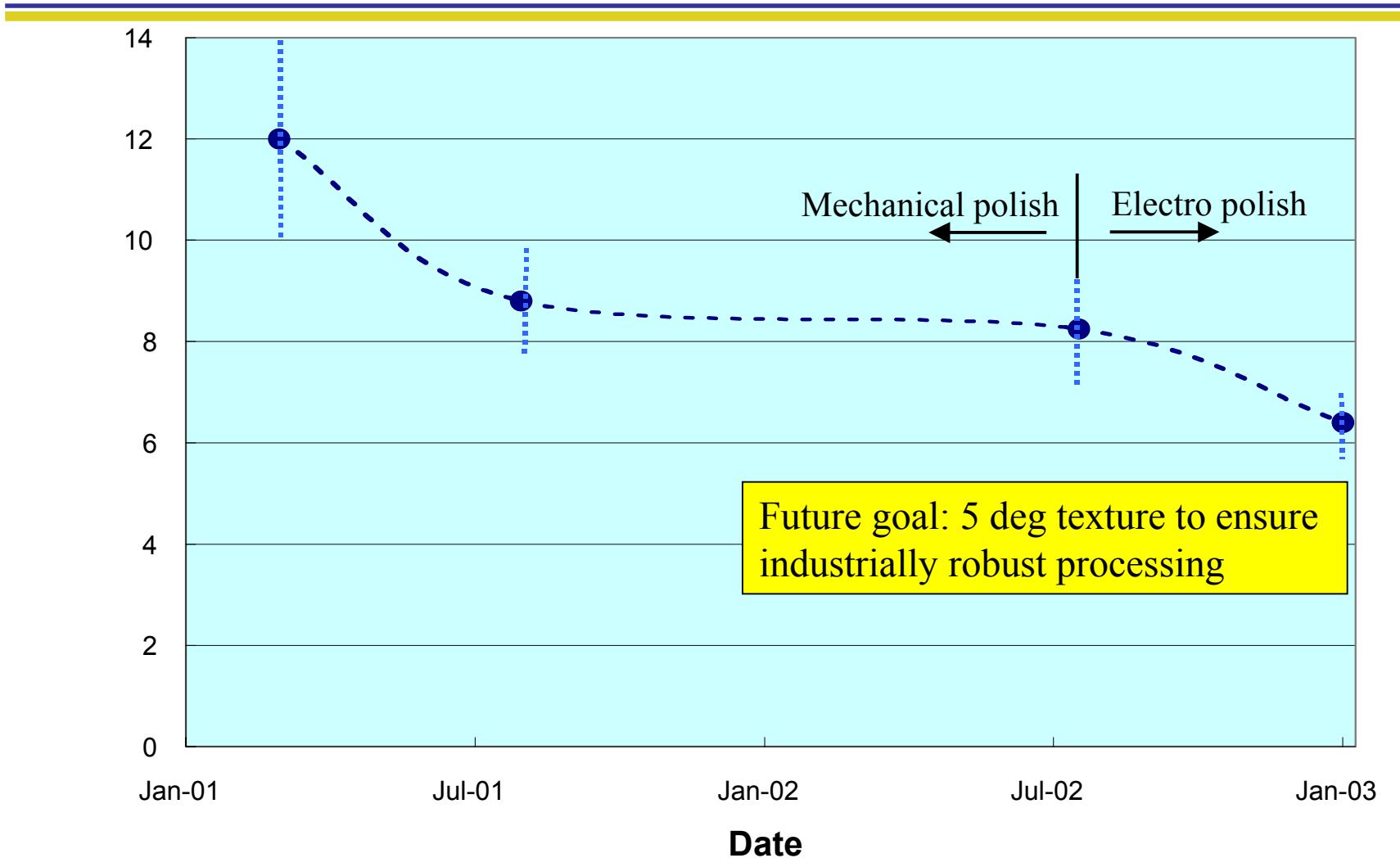


Homoepi MgO/IBAD MgO/*a*-Y₂O₃/Ni-alloy

In-plane texture history for continuously processed IBAD MgO templates



In-plane texture history for continuously processed IBAD MgO templates



Summary

Substrates used are commercially available alloys

Substrate polishing is done using industrially scalable electro polishing process (need to further elucidate texture dependence on surface finish)

Processing speed calculations indicate ~ 2000 km/yr per IBAD system can be made using present deposition methods

Current IBAD MgO template textures result in highly textured YBCO with high I_c , J_c properties

Future goals are to further improve robustness of template processing